European Patent No. 0998539 (98932436.3)
E.I. du Pont de Nemours and Company
Appeal No. T894/05-3.3.1

Requests

The patentee submits amended requests to be considered by the Appeal Board. The requests are discussed in detail below.

In summary, the main and first to third auxiliary requests are based upon those filed with the patentee's grounds of Appeal, with the re-introduction of the two use claims, corresponding to claims 17 and 18 of the main request considered by the Opposition Division.

The dependent composition claim corresponding to claim 12 of the main request considered by the Opposition Division has also been limited to a formulation of 46% by weight pentafluoroethane, 50% by weight 1,1,1,2-tetrafluoroethane and 4% by weight n-butane in the requests.

A new fourth auxiliary request is also submitted. This request limits the independent composition claim to a blend of 46% by weight pentafluoroethane, 50% by weight 1,1,1,2-tetrafluoroethane and 4% by weight n-butane. The use, process and apparatus claims mirror those of claims 15-21 of the Main Request considered by the Opposition Division, with various minor amendments, discussed in detail below.

Documents

The following new documents are enclosed with the confirmation copy of these submissions:

D16 ASHRAE Transactions 2002, V.108, Pt 2, 739-756, HI-02-7-2(RP-1073)

D17 Test protocol for determination of refrigerant properties

D18 Energy Saving Refrigerant Blends, 17-18 June 2005, Neil A. Roberts

D19 Vapour composition flammability data for binary and ternary blends

These documents are filed in direct response to submissions made by the opponent in its grounds of Appeal. D16 and D18 were published after the filing date of the patent in suit and are therefore not prior art to the present invention. These documents are provided as evidence in support of technical arguments presented below.

D16 provides a summary of data of Lower Flammability Limits for various refrigerant components. D17 details the test protocol used to determine the refrigerant properties disclosed in the patent in suit. D18 and D19 provide further evidence of the technical effects of the present invention. D18 shows the utility of the refrigeration compositions of the invention as replacements for chlorodifluoromethane in a variety of air conditioning and refrigeration units.

D19 shows the nonflammability of modelled vapour compositions of a variety of formulations according to the requests.

Main Request

The amended main request corresponds to the main request filed by the patentee with its grounds of Appeal, with the introduction of two use claims 18 and 19. The basis for claims 1-11 and 13-17 of the main request was discussed at page 2, line 16 to page 7, line 14 of the patentee's grounds of Appeal.

Claim 12 has been limited to specify the composition 46% pentafluoroethane, 50% 1,1,1,2-tetrafluoroethane and 4% by weight n-butane. Basis for this amendment is found at page 4, lines 10-16 of the application as filed.

Claim 18 corresponds essentially to use claim 16 as granted, with the limitation of the range of unsubstituted hydrocarbon component to 1 to 5% by weight, and claim 17 of the main request considered by the Opposition Division and appealed in the patentee's Notice of Appeal. Basis for the limitation of the range is found in the disclosures of the range of 1 to 10% and the particularly preferred range of 2 to 5% by weight in the application as filed at page 3, lines 10-12. In accordance with T 2/81, the range of 1 to 5% by weight for component (ii) is directly derivable from the limits of these ranges.

Basis for the remaining features of the composition is found at page 2, line 21 to page 3, line 3 of the application as filed. Reference to octafluoropropane (R218) was deleted from the definition of component (a) (component (iii) of the requests) prior to grant. The removal of a single component from a list of alternatives does not introduce a new technical teaching to the skilled person.

Claim 18 is directed towards the use of the refrigeration composition as a replacement for chlorodifluoromethane. Basis for this wording is found in the statement of invention at lines 9-12 of page 1 of the application as filed, which states that the refrigerant compositions of the invention are particularly "for use as replacements in refrigeration equipment currently employing, or designed to employ, the refrigerants R12 and R22". The refrigerant R22 is chlorodifluoromethane. Claim 18 therefore meets the requirements of Article 123(2) EPC.

Claim 19 relates to the use according to claim 18 of a composition defined in claim 12. The composition according to claim 12 is disclosed at page 4, lines 10-16 of the application as filed. For similar reasons to claim 18, the basis for use claim 19 is found at lines 9-12 of page 1 of the application as filed, which state that the compositions of the invention can be used as replacements for chlorodifluoromethane. Furthermore, it is apparent from the Refrigeration performance data at page 6 of the application as filed that Example 1, which corresponds to the specified composition, is useful as a replacement for R22 (chlorodifluoromethane). Claim 19 therefore meets the requirements of Article 123(2) EPC.

Use claims 18 and 19 corresponding essentially to claims 17 and 18 of the Main Request considered by the Opposition Division, which forms part of the

present Appeal in accordance with the patentee's notice of Appeal of 30 June 2005.

Use claim 17 considered by the Opposition Division related to "use, as a refrigeration composition able to replace chlorodifluoromethane, of a refrigeration composition" with the specified composition. Corresponding claim 18 in the present main request has been amended to relate to "use of a refrigerant composition as a replacement for chlorodifluoromethane, said composition" having the specified composition.

The amended wording explicitly limits the use of the composition to that as a replacement for chlorodifluoromethane. By implication, the three components (i), (ii) and (iii) of the composition are therefore replacements for R22. Consequently, the terms "as a replacement for chlorodifluoromethane" applied to components (ii) and (iii) in the corresponding granted claim 16, are redundant over the amended wording and have not been retained in claim 18 of the main request. For these reasons, there is no extension of protection of the subject matter of claim 18 compared to that of claim 16 as granted, and this claim conforms to the requirements of Article 123(3) EPC.

The main request therefore meets the requirements of Article 123 EPC.

First Auxiliary Request

The amended first auxiliary request corresponds to the first auxiliary request filed with the patentee's grounds of Appeal with the introduction of two use claims 16 and 17. The basis for claims 1-9 and 11-15 of the main request was discussed at page 8, line 30 to page 9, line 15 of the patentee's grounds of Appeal.

Claim 10 has been limited to specify the composition 46% pentafluoroethane, 50% 1,1,1,2-tetrafluoroethane and 4% by weight n-butane. Basis for this amendment is found at page 4, lines 10-16 of the application as filed.

Claim 16 of the first auxiliary request corresponds to claim 18 of the main request with the limitation of the chemical compounds which constitute components (i) and (ii). These limitations bring the definitions of components (i) and (ii) into line with the corresponding independent composition claims 1 and 4.

Basis for the limitation of component (i) to pentafluoroethane and/or 1,1,1,2-tetrafluoroethane is found at page 3, lines 21-23 of the application as filed, which state that component (b) (corresponding to component (i)) preferably comprises R125 (pentafluoroethane) and/or R134a (1,1,1,2-tetrafluoroethane). Basis for the limitation of component (ii) to a hydrocarbon of 4 or 5 carbon atoms (i.e. n being 4 or 5) is found at page 4, lines 2-4 of the application as filed.

The basis for the remaining features of claim 16 and claim 17 has been discussed for corresponding claims 18 and 19 of the main request above.

For these reasons, the first auxiliary request fulfils the requirements of Articles 123(2) and 123(3) EPC.

Second Auxiliary Request

The amended second auxiliary request corresponds to the second auxiliary request filed with the patentee's grounds of Appeal with the introduction of two use claims 12 and 13. The basis for claims 1-5 and 7-11 of the second auxiliary request was discussed at page 9, line 18 to page 10, line 5 of the patentee's grounds of Appeal.

Claim 6 has been limited to specify the composition 46% pentafluoroethane, 50% 1,1,1,2-tetrafluoroethane and 4% by weight n-butane. Basis for this amendment is found at page 4, lines 10-16 of the application as filed.

Claim 12 of the second auxiliary request corresponds to claim 16 of the first auxiliary request with the further limitation of the chemical compounds which constitute components (i) and (ii). These limitations bring the definitions of components (i) and (ii) into line with the corresponding independent composition claims 1 and 3.

Basis for the limitation of component (i) to 1,1,1,2-tetrafluoroethane is found at page 3, lines 21-23 of the application as filed, which state that component (b) (corresponding to component (i)) preferably comprises R134a (1,1,1,2-tetrafluoroethane). Basis for the limitation of component (ii) to n-butane is found at claim 12 and page 4, lines 8-9 of the application as filed.

The basis for the remaining features of claim 12 and claim 13 has been discussed for corresponding claims 18 and 19 of the main request above.

For these reasons, the second auxiliary request fulfils the requirements of Articles 123(2) and 123(3) EPC.

Third Auxiliary Request

The amended third auxiliary request corresponds to the third auxiliary request filed with the patentee's grounds of Appeal, with the introduction of two use claims 10 and 11. The basis for claims 1-3 and 5-9 of the third auxiliary request was discussed at page 10, lines 7-20 of the patentee's grounds of Appeal.

Claim 4 has been limited to specify the composition 46% by weight pentafluoroethane, 50% by weight 1,1,1,2-tetrafluoroethane and 4% by weight n-butane. Basis for this amendment is found at page 4, lines 10-16 of the application as filed.

Claim 10 of the third auxiliary request corresponds to claim 12 of the second auxiliary request with the further limitation of component (i), namely 1,1,1,2-tetrafluoroethane, to 50% by weight. Basis for this amendment is found at page 3, lines 36-37 of the application as filed, in the specific disclosure of the lower limit in the generic range of 50 to 90% by weight. This limitation brings

the definition of component (i) into line with the corresponding independent composition claim 1.

The basis for the remaining features of claim 10 and claim 11 has been discussed for corresponding claims 18 and 19 of the main request above.

For these reasons, the third auxiliary request fulfils the requirements of Articles 123(2) and 123(3) EPC.

Point 1 of the opponent's grounds of Appeal raises various objections under Article 123 EPC against claims 1 and 7 of the claim set allowed by the Opposition Division. This claim set corresponds generally to the third Auxiliary Request now on file.

The opponent has argued that a new technical teaching has been introduced by relying upon the proportion of 50% of R134a in the examples to provide the basis for limiting the proportion of R134a in the independent claims.

This objection relies upon a false assumption and was dealt with at page 10, lines 25-29 of the patentee's grounds of Appeal. Contrary to the opponent's understanding, generic basis for a value of 50% is provided in the general disclosure of the range of 50-90% of component (i) (corresponding to component (b) as filed) at page 3, lines 36-37 of the application as filed. It is accepted practice that a numerical limit of a generic range provides basis for a generic value corresponding to one of these limits.

Furthermore, R134a is disclosed as a preferred compound for component (b) at page 3, lines 22-23 of the application as filed. Consequently, there is basis for limiting component (i) to R134a in an amount of 50% by weight in the compositions of the invention.

In point 1.7 of the opponent's grounds of Appeal, it has alleged that the independent use claim (now claim 10) is in the open format such that other unspecified components may be present. The opponent's reasoning does not lead to the introduction of a new technical teaching. The broadest formulation of the refrigerant compositions is found in claim 10 and the corresponding portion of the description at page 2, line 21 ff. of the application as filed. This text discloses ranges of 5-60% by weight, 30-94% by weight and 1-10% by weight for components (a), (b) and (c) (corresponding to claimed components (iii), (i) and (ii)) . It has already been shown that the more limited ranges of 1-5% by weight hydrocarbon content also has explicit generic basis in the application as filed, based upon the ranges of 1-10% and 2-5% by weight. The selection of such ranges therefore does not introduce subject-matter which was not present in the application as filed.

It is further pointed out that page 1, lines 9-12 of the application as filed states that the compositions of the invention can be used as replacements in refrigeration equipment currently employing, or designed to employ, the refrigerants R12 and R22 (chlorodifluoromethane). It is apparent from the proceeding paragraph that R12 and R22 are not used together, but for different purposes i.e. one commonly as a domestic refrigerant and the other principally for air conditioning (but also for commercial refrigeration systems). It is

therefore unambiguous that all the formulations of the invention can be used as replacements for R22. There is no disclosure in the application to the contrary. Thus, there is no new technical teaching introduced by specifying the use of a composition which is derivable from the application as filed (as discussed above) as a replacement for chlorodifluoromethane.

In point 1.8, the opponent has alleged that the independent claims represent a technical teaching which was not present in the application as filed because of the combination of R125 with a particular proportion range of R600. The opponent has pointed to page 2, lines 23-28 of the application as filed and noted that this provides insufficient basis for such a combination. The basis for this amendment is found elsewhere in the specification. The cited portion of text discloses a number of materials as alternatives for component (a) of the composition. However, this list is reduced to two preferred components, one of which is pentafluoroethane (R125) at lines 21-22 of page 3. There is no new technical teaching in the limitation of a composition to a preferred compound for a particular component.

Furthermore, reading the cited portion of the text in its entirety, preferred combinations of both components (a) and (b) are disclosed. The combination of R125 as component (a) and R134a as component (b) is disclosed as one of only two alternatives when components (a) and (b) are different (the other alternative being the combination of R218 and R125). R600 is also disclosed as the preferred material for component (c) at page 4, lines 8-9. Consequently, there is no new technical teaching in the selection of these preferred components with specifically disclosed ranges of 1-4 % R600 and 50% R134a.

For these reasons, the third auxiliary request fulfils the requirements of Article 123 EPC.

For completeness, it is noted that these arguments are also applicable to the corresponding claims of the other requests. They will not be repeated for each request on the grounds of brevity.

Fourth Auxiliary Request

The fourth auxiliary request corresponds to the amended main request, with the limitation of the composition claims to a single formulation, namely 46% pentafluoroethane, 50% 1,1,1,2-tetrafluoroethane and 4% by weight n-butane. Basis for this composition is found at page 4, lines 10-16 of the application as filed as sample (a) and in Example 1.

Claims 2-8 of the fourth auxiliary request correspond to claims 13-18 of the main request, and the basis for these claims is discussed for the main request above.

For these reasons, the fourth auxiliary request fulfils the requirements of Articles 123(2) and 123(3) EPC.

Admissibility of D1

The opponent has filed a sworn Declaration, D13, indicating that document D1 was made available to conference registrants on 14 July 1998. In the light of this Declaration, the patentee does not intend to further dispute that D1 was available on that date.

D1 is therefore an intervening document which was made available between the priority and filing dates of the patent under Appeal. D1 will not be prior art for any claims which have a valid claim to the earlier priority date. The patentee firmly believes that the independent claims of the requests can validly claim priority from GB9714880.3, filed on 15 July 1997.

In the light of the above, it is requested that any analysis of the priority claim be remitted to the Opposition Division, as the Department of first instance, for consideration, as discussed in the patentee's grounds of Appeal at page 12, lines 22-28,. This will allow the Opposition Division to rule on the validity of the priority claim for the first time, and provide both the patentee and opponent with the opportunity to file an Appeal to the Division's decision on priority, if necessary.

Priority

The patentee provides the following comments on the validity of the priority claim for the requests currently on file, in response to the opponent's objections.

In point 2.2 of the opponent's submissions, it has alleged that claims 1-3, 5, 6, 8 and 9 of the claim set allowed by the Opposition Division cannot validly claim priority from the priority application filed on 15 July 1997. This reasoning is based on the allegation that there is no disclosure in the priority application of a range of 1-4% for hydrocarbon component (ii) specified in the independent composition claims.

This range of hydrocarbon content is common to the composition claims of the main and first to third auxiliary requests. The following comments are therefore applicable to these requests.

Article 87 EPC provides a right to priority in respect of the same invention disclosed in a European application and a priority application. G 2/98 (Headnote) states that the "priority of a previous application in respect of a claim in a European patent application ... is to be acknowledged only if the person skilled in the art can derive the subject-matter of the claim directly and unambiguously, using common general knowledge, from the previous application as a whole".

It is submitted that the skilled person could derive a range of 1-4% by weight for the hydrocarbon from the priority application, such that the subject-matter of the independent composition claims of the main and first to third auxiliary requests is present in the priority application.

In this regard, the priority application discloses a broad range and a number of preferred narrower generic ranges for the hydrocarbon content. Ranges of 1-10% together with consecutively more preferred ranges of 1-8%, 2-6% and 2-5% by weight for the hydrocarbon component are disclosed at lines 31-32 of page 2 of the priority application. It is also apparent that in accordance with T 2/81, the ranges of 1-5% and 2-8% by weight, among others, are also unambiguously derivable from the stated ranges.

The explicitly disclosed upper limits of the hydrocarbon range are stated to be 10%, especially 8%, preferably 6% and more preferably 5% by weight (GB9714880.3, page 2, lines 31-32). It would therefore be clear to the skilled person that the lower values of the upper limit of this range are increasingly preferred. Indeed, the two Examples, 1 and 4 (Examples 2, 3 and 5 are comparative Examples) in the priority application utilise 3% and 4% by weight hydrocarbon content. The skilled person would therefore have understood not only that the invention could be operated at such a content of hydrocarbon, but also that these values were preferred representing both specific formulations and continuations of the trend presented by the reduction in the preferred upper limit of the hydrocarbon content.

Consequently, the skilled person would unambiguously derive a limit of 4% by weight hydrocarbon from Example 1 of the priority application. The subject matter of the range of 1-4% by weight hydrocarbon is therefore unambiguously derivable from this document.

Indeed, comparing these range of 1-4% and 1-5% using the EPO's criteria for assessing selection inventions, the derived range of 1-4% would not be considered novel over the explicit generic disclosure of a range of 1-5% by weight. Firstly, the sub range is not narrow. The range of 1-4% represents 80% of the derived range of 1-5% by weight. The range of 1-4% by weight is not removed from the preferred part of the known range, as illustrated by the examples, which disclose hydrocarbon contents of 3 and 4% by weight (Examples 1 and 4). In addition, the range of 1-4% does not appear to provide a new technical effect, when compared to a range of 1-5% by weight. Both ranges provide formulations which reduce the flammability of a fractionated composition.

Consequently, it is submitted that the hydrocarbon range of 1-4% by weight is derivable from the priority application, such that the priority claim of the independent composition claims of the main and first to third auxiliary requests is valid.

In point 2.2.3 of the opponent's grounds of Appeal, it has noted that the formulation R125 46.5%, R134a 50%, R600 3.5% by weight is not found in the priority application. Claim 12 of the main request and the corresponding claims of the first (claim 10), second (claim 6) and third (claim 4) auxiliary requests have been limited to the formulation R125 46%, R134a 50%, R600 4% which is disclosed as Example 1 in the priority application and therefore has a valid priority claim.

This example also forms the basis for the independent composition claim in the fourth auxiliary request and is disclosed at page 3, lines 29-32 of the priority

application. Composition claim 1 of the fourth auxiliary request therefore has a valid priority claim

In point 2.2.4 and 2.2.5 of its grounds of Appeal, the opponent has noted that claim 11 of the PCT application as filed, which specifies that the hydrocarbon should have 4 or 5 carbon atoms, is not present in the priority application. Although this claim is not present in the priority application, the corresponding subject-matter can be found at page 3, lines 22-23, which states that that typical hydrocarbons which can be employed possess 4 or 5 carbon atoms.

For the avoidance of doubt, it is also pointed out that the priority application states at line 26 of page 3 that n-butane is a particularly preferred hydrocarbon for the refrigerant formulations. Similarly, pentafluoroethane (R125) is disclosed as a preferred component (a) (corresponding to component (iii) as claimed) and 1,1,1,2-tetrafluoroethane (R134a) is disclosed as a preferred component for component (b) (corresponding to component (i) as claimed) at page 3, lines 5-6 of the priority application. These features are disclosed in the priority application in a generic sense, and not associated with any other features. A composition directed towards the preferred compounds for the three components is therefore derivable from the priority application.

For completeness, it is pointed out that the independent use claim of the requests also has a valid priority claim. The hydrocarbon range of 1-5% specified in these requests is directly derivable from the disclosure of the generic ranges of 1-10% and 2-5% by weight at lines 31-32 at page 2 of the priority application in accordance with T 2/81. The remaining features of the use claim are found at page 1, lines 4-6 and page 2, lines 15-29 of the priority application.

Consequently, it is submitted that the subject-matter of the features discussed above is unambiguously derivable from the priority application.

Novelty

In point 2.3 of the opponent's grounds of Appeal, D1 has been cited against the novelty of claims 1 to 9 (which correspond to claims 1 to 9 of the third auxiliary request). The availability of D1 as prior art was based upon the argument that the hydrocarbon range of 1-4% by weight was not derivable from the priority application. However, it has been shown that this range does form part of the subject-matter derivable from the priority application. Consequently, D1 is not available as prior art for the analysis of novelty of the independent composition claims of the main and first to third auxiliary requests.

With regard to composition claim 1 of the fourth auxiliary request, this is based upon Example 1 of the priority application, and thus also has a valid priority claim. Consequently, D1 is not available as prior art for the analysis of novelty of the independent composition claim of the fourth auxiliary request.

It is also pointed out that the independent use claims of the requests has a valid priority claim, as discussed above in relation to the hydrocarbon range of 1-5%

by weight. Consequently, D1 is not available as prior art for the analysis of novelty of the independent use claim of all of the requests.

In point 2.4 of the opponent's grounds of Appeal, it has argued that the claims lack novelty over the disclosure of D2, alleging that the Opposition Division was in error by concluding that a selection was required to arrive at a composition falling within the claims. These arguments were dealt with in the discussion of novelty in pages 12-14 of the patentee's grounds of appeal. As discussed, there is neither an explicit nor an implicit disclosure of a composition falling within the claims of the requests in D2. Consequently, the requests are novel over D2.

For these reasons, the claims of the requests fulfil the requirements of Article 54 EPC.

Inventive step

In point 3.3 of its grounds of Appeal, the opponent has argued that the Opposition Division was in error in examining whether the patent was obvious in the light of the teaching of the prior art, based upon the technical effect of the patent. The patentee disagrees.

It is settled practice under the problem-solution approach to the analysis of inventive step that the technical problem which the invention solves is objectively formulated in the light of the closest prior art. The objective definition of the problem to be solved by the invention should normally start from the problem described in the patent. This is the procedure adopted in the present case, both by the Opposition Division and in the patentee's grounds of Appeal at pages 15-18.

The technical problem in the light of the disclosure of D2 has been formulated as the provision of alternative refrigerant compositions, useful to replace R22, having reduced flammability upon leakage (patentee's grounds of Appeal, page 16, paragraph 2).

The opponent has stated that it is normal jurisprudence of the Appeal Boards that when the prior art suggests a solution as being advantageous, the solution is obvious even if there are additional effects (the so-called "bonus effect"). However, it is pointed out that the cited art must suggest a solution to the objective technical problem.

In point 3.4 of its grounds of Appeal, the opponent has noted that D3 discloses that n-butane mixtures are preferred, and it therefore would be the obvious choice of hydrocarbon in the compositions of D2.

The cited portion of text in D3 at page 3, lines 44-46 states that "Moreover the mixtures containing n-butane are preferred to those containing isobutane; this was unexpected as the azeotropic or near-azeotropic behaviour usually is found more easily when the boiling points of the components are closer".

This discussion of n-butane and isobutane is in relation to the azeotropic and near-azeotropic behaviour of the compositions. It does not address the

reduced flammability of n-butane formulations compared to those of isobutane. One measure of such near-azeotropic refrigerant mixture behaviour is the amount of refrigerant vapour pressure change after 50% of the refrigerant weight has been removed as vapour. This test simulates a vapour leak of refrigerant from a system and is presented in Table 1 of D3. This property is determined by measuring the percentage change in the refrigerant vapour pressure $\Delta P/p$ 100 i.e. the refrigerant vapour pressure change after a particular percentage leakage divided by the initial refrigerant vapour pressure.

If the pressure change is less than 10% after the 50% weight loss, the mixture can be termed as near-azeotropic. This test is used in D3 to demonstrate that mixtures of R125/R134a with n-butane were slightly more near-azeotropic than the same mixtures with isobutane substituted for n-butane. This would appear to be the reason why D3 states that n-butane is preferred to those of isobutane.

In Table 1 at page 6 of D3, mixtures 1 and 7 have essentially similar concentrations of R125, R134a and hydrocarbon. However, mixture 1 uses butane as the hydrocarbon while mixture 7 uses isobutane. A $\Delta P/p$ 100 of 4.72% at 50% leakage and 10.98% at 90% leakage is disclosed for mixture 1 (containing n-butane). Mixture 7, which contains isobutane rather than n-butane has $\Delta P/p$ 100 of 5.03% at 50% leakage and 12.08% at 90% leakage. The smaller percentages of $\Delta P/p$ 100 for the n-butane mixture 1 would have suggested to the skilled person that the n-butane mixture is slightly closer to near-azeotropic behaviour than corresponding isobutane-containing mixture 7. This conclusion is reflected in the portion of text cited by the Opponent.

However, lines 44-46 at page 3 of D3 would appear to contain no teaching to the skilled person regarding the relative merits of n-butane and isobutane with respect to flammability, but only in relation to the near-azeotropic properties of the mixtures.

Furthermore, the cited portion of text in D3 concludes a paragraph relating to mixtures containing 75-86% R134a and 4-20% R125 and 2-4% R600 and/or R600a i.e. different proportions of components compared to those of the present invention (D3, page 3, lines 41-46). The recited compositions of R600 and/or R600a were found to be nonflammable, while those mixtures containing only a little more than 4% of hydrocarbon were said to be found to be slightly flammable. Thus, in relation to flammability, no distinction would appear to be made between isobutane and n-butane. This disclosure would therefore not have led the skilled person to expect any improvement in the nonflammability properties of compositions utilising n-butane when compared to isobutane, and in particular any improvement in compositions having different proportions of R134a and R125.

In point 3.5 of the opponent's grounds of Appeal, it has alleged that the reduction in flammability achieved by n-butane is confirmed by D14. The documents comprising D14 disclose an explosive limit for isobutane in air which is 1.3% by volume, and a limit of 1.5% for n-butane in air. These values are at the low end of the commonly accepted values for these hydrocarbons. It is apparent from pages 747 and 754 of D16, an ASHRAE Determination of Lower Flammability Limits (LFLs), that n-butane was known to have an LFL of 1.5-2.0 and isobutane an LFL of 1.6-1.8, the main consensus being

essentially similar values for their LFLs. It is apparent from at least footnote (b) of Table 4 at page 754 of D16 that butane and isobutane were know to have essentially identical LFLs as of 1985.

The main determinant of flammability of a refrigerant mixture is the hydrocarbon content of the vapour (or liquid) phase, and not small differences in the hydrocarbon LFL values. This is demonstrated in a comparison of Examples 1 and 2 of the patent under Appeal. These examples relate to the same liquid compositions of R125/R134a and hydrocarbon. Example 1 uses n-butane, while Example 2 uses isobutane at an identical content of 4% by weight (liquid). The table on page 5 of the patent titled Fractionated and Flammability test results shows that the vapour phase of Example 1 has 4.7% by weight n-butane and is nonflammable, while the vapour phase of Example 2 has 6.5% by weight isobutane and is flammable.

The higher concentration of isobutane in the vapour phase is due to the molecular interactions among the functional groups of R125, R134a and isobutane and cannot be predicted from a LFL. It is clear from a comparison of Examples 1 and 2 that the molecular interactions are different for n-butane and isobutane, with less n-butane being present in the vapour phase. The difference in behaviour of the two compositions was determined by laboratory testing and could not have been expected from essentially similar LFL values.

It is pointed out that Table 1 of D2, the closest prior art, discloses the hydrocarbons propane, propylene, n-butane and 2-methyl propane. If the skilled person were to have investigated alternatives to isobutane based upon LFL, both propane and propylene would have been pursued in favour of n-butane, because these hydrocarbons have significantly higher LFLs. Literature LFLs show a range of 2.0-2.7 vol.% for propylene (R1270, D16, pages 748, 754) and 2.1-2.37 vol.% for propane (R290, D16, pages 747, 754). This data means that higher amounts of propane or propylene are required to initiate flammability compared to n-butane or isobutane.

It is pointed out that some propylene LFL data summarised in D16 dates from 1981-1997 (see footnotes (11) on page 748 and (b) and (d) on page 754 of D16), and some propane LFL data dates from 1981-1997 (see footnotes (1), (11), (13) on page 748 and (b) and (d) on page 754). This data would therefore have been available to the skilled person at the priority data of the patent under Appeal. Consequently, based upon the opponent's reasoning, the skilled person attempting to obtain a composition with lower flammability based upon a selection of higher LFL hydrocarbons would choose propane or propylene over n-butane or isobutane. Consequently, a consideration of LFL would not have led the skilled person to the hydrocarbon components according to the compositions of the requests, but directed the skilled person towards investigating propane and propylene.

The opponent has filed and discussed a new document, D15, in points 3.6-3.9 of its grounds of Appeal. D15 was published in 2005 and therefore is neither prior art for the present proceedings nor representative of the understanding of the skilled person either at the priority date or filing date of the patent in suit. This document is therefore not prima facie relevant to a ground of Opposition

and it is requested that the Appeal Board exercise its discretion and not admit it into the proceedings.

If the Appeal Board is minded to consider this document, the following comments are provided. In points 3.6, 3.7 and 3.9 of the opponent's grounds of Appeal, it has argued that it is not possible to view blend R417A, (R125 46.6%/ R134a 50%/ R600 3.4% by weight), a composition falling within the claims of the requests, as being equivalent to R22. However, R417A is a successful commercial replacement for R22.

The opponent has pointed to Figures 5 and 6 of D15 and alleged that the refrigeration effect and coefficient of performance of R417A is significantly inferior to those of R22 and has questioned the validity of the refrigeration performance effect shown in the patent under Appeal. In the first instance, it is pointed out that the tests of D15 were run in different types of systems, and with different operating conditions compared to those described in the patent in suit. Different testing regimes would not be expected to provide identical data. This is apparent from an examination of D17 which provides a discussion of the system and conditions used to generate the data in the patent under Appeal.

Furthermore, the patentee disputes the conclusion of the opponent that D15 shows that the properties of the R417A composition according to the invention were significantly inferior to that of R22. The data for ambient temperatures in D15 at Figures 5 and 6, show that blend R417A (of the invention) has cooling capacity values 80 to 88% of the other refrigerants of Figure 5. The coefficient of performance (COP) values of R417A in the same ambient temperature range are 86 to 100% of the other refrigerants in Figure 6. These differences are specific to the particular system tested and are within the variances of most common systems, which are often overdesigned by 10-15% in capacity in order to accommodate additional loads and/or occasionally high ambient temperatures.

The inventor of the patent under Appeal also presented a paper at the same conference as D15. A copy of this paper is provided as D18, in direct response to the subject-matter of D15, should the latter be admitted into the proceedings. The inventor's paper presents the operating performance of blend R417A (according to the invention) as a retrofit refrigerant for R22 in several air conditioning and refrigeration systems. The change from R22 to R417A was found to be successful in all the examples presented, showing cooling capacities as needed in the equipment and similar or improved energy consumptions (D18, page 3, paragraph 1, final sentence). Thus, the compositions of the invention have been shown to be useful to replace R22.

It is important to recognise the range of refrigeration and air conditioning systems in the industry, and how the design and operating conditions of these systems impact the system cooling capacity and energy efficiency. For example, subcooling has a greater beneficial effect for R417A according to the invention than for R22, and at equal to more subcooling for R417A systems, the capacity and COP deficits for R417A will not be as great as that shown in Figures 5 and 6 of D15. Indeed, millions of kilograms of R417A have been

sold for retrofit of R22 systems, with successful results and repeat sales to customers for both air conditioning and refrigeration applications.

In point 3.8 of its grounds of Appeal, the opponent has questioned the technical effect occurring throughout the range of claimed compositions. D19 enclosed herewith contains modelled blend data for a variety of compositions falling within the claims of the requests. The data was generated using Blendy, a proprietary refrigerant properties program developed by the patentee. This program is not publicly available, and so such modelled data would not have been available to the skilled person at the priority date of the patent under Appeal.

Liquid compositions of the various blends were modelled to determine the compositions of the resulting initial vapour phase at -20°C. The hydrocarbon content of the calculated vapour blends correlated strongly with the corresponding experimental data observed for Examples 1 and 2 in the patent in suit. In particular, Example 1 shows a vapour composition containing 4.7% by weight n-butane in the Table at page 5 of the granted patent. The corresponding modelled n-butane vapour content is in good agreement at 4.9% by weight. Similarly, Example 2 shows a vapour composition containing 6.5% by weight isobutane in the Table. The corresponding modelled isobutane vapour content provides an identical value of 6.5% by weight. It is therefore believed that the Blendy program accurately reflects the initial vapour hydrocarbon content of a particular blend.

The inventive compositions were modelled in the range of 21 to 60% by weight component (iii) and 75 to 36% by weight component (i), for a constant hydrocarbon content of 4% by weight. These minimum and maximum contents for components (i) and (iii) are derived from the composition claims of the main, first and second auxiliary requests for the chosen hydrocarbon content. This hydrocarbon concentration was selected to be 4% by weight because this represents the maximum hydrocarbon content falling within the composition claims. These compositions would therefore be expected to provide the highest level of flammability, in relation to the hydrocarbon.

Blends with compositions falling around the preferred formulation of 50% by weight component (i), 4% by weight component (ii) (hydrocarbon) and 46% by weight component (iii) were also modelled, together with the corresponding binary blends of 96% by weight R125 (as components (i) and (iii)) and 4% by weight hydrocarbon.

Blends comprising R125 (pentafluoroethane), R134 (1,1,2,2-tetrafluoroethane), R134a (1,1,1,2-tetrafluoroethane) or R227ea (1,1,1,2,3,3,3-heptafluoropropane) for component (i); n-butane, n-pentane, cyclopentane or 2-methyl butane for component (ii); and R125 (pentafluoroethane) for component (iii) were modelled.

These formulations cover a sample of blends falling within the composition claims of the main and first to fourth auxiliary requests.

The nonflammability of the calculated initial vapour compositions was determined from laboratory flammability/nonflammability test data obtained

from ASTM D681 tests. This testing regime was used to provide the flame boundaries of all the ternary and binary blends modelled.

It is apparent from the data in D19 that none of the initial liquid compositions according to the invention yielded an initial vapour composition which was flammable according to ASTM D681. In contrast, the corresponding isobutane-containing compositions were found to yield flammable initial vapour compositions for the 21% R125/ 75% R134a/ 4% by weight R600a and 46% R125/ 50% R134a/ 4% by weight R600a blends.

Consequently, the initial vapour content of those formulations according to the present invention modelled by the Blendy program was found to be nonflammable, while the corresponding closest prior art formulation according to Table 3 at page 4 of D2, namely 46% R125/ 50% R134a/ 4% by weight R600a, was found to be flammable. Thus, the compositions of the present invention provide nonflammable refrigerant formulations in accordance with the proposed technical problem.

For these reasons, it is submitted that the claims of the requests meet the requirements of Article 56 EPC.

Conclusions

It is requested that the patent be maintained on the basis of the main or one of the first to fourth auxiliary requests.

James B Thomson
Professional Representative

30 March 2006